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A STUDY OF THE GROWTH OF THE HOOFS OF NATIVE HORSES[1]

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The following study was undertaken with the object of ascertaining the rate of growth of the normal and healthy hoofs of native (Filipino) horses, which might be of some interest both to practicing veterinarians and animal husbandmen. In searching the literature on the subject I was not able to find any previous work on the hoofs of native horses, and I noticed that the observations on the rate of growth of the hoofs of horses of foreign breed are not at all uniform.

It has long been recognized by many interested in animals that the ability of the horse to perform labor depends largely, if not wholly, upon his possession of four good, sound feet. The horse's feet, exposed as they are, to multiple injuries in the pasture as well as in the road, are not infrequently the most common seat of various diseases which cause lamness and affect the value of the animal. The veterinarians, when called upon to treat injuries or diseases of the hoof of horse's foot,—such as cracks, clefts, quittor, side-bone, keratoma, etc.,—that require cutting or removal of portions of horn tissue, are confronted with one simple but important question: How much time is necessary for the repair of the injured or removed horn tissue and to put the animal back into work? The answer to this question is also simple and requires only a little mental figuring. When one knows the rate of growth of the normal and healthy hoofs under normal condition, it is not a difficult matter to compute the length of time that would be required to repair the injured or diseased part.

Animal husbandmen, in buying horses for breeding purposes, always select those which possess the qualities and characters that they desire to be transmitted to the offspring, on the assumption that the good and bad points of the young are inherited from their parents. The applicability of the principle of heredity in breeding is beyond question, but at the same time one should not overlook the fact that there are certain defects of horse's foot, like for instance, contracted heels, clubfoot, crookedfoot, etc., that are acquired due to improper care of the hoof, especially during colthood. Conditions of this kind should not be attributed only to faulty trimming and paring of the hoofs but also to lack of knowledge on the part of the caretaker as regards the amount of horn tissue to be removed after a certain length of time.

[1] Experiment Station Contribution No. 112.

For this experiment ten selected horses were used, five of which were from the Animal Husbandry Department, College of Agriculture, and the rest from the "in-cases" in the Veterinary Hospital, College of Veterinary Science. The selection of the horses was based principally upon the soundness of the feet, age, sex, and general condition of the body.

Of the five horses from the College of Veterinary Science, two were suffering from epizootic lymphangitis, one from acute tendinitis in one of the posterior limbs, one from burn, and one from melanotic tumor. All these five animals, in spite of the maladies they were suffering from, were in fairly good body condition. The horses from the Animal Husbandry Department were all sound and healthy and used only for experimental and breeding purposes. Of these ten horses, five were stallions, one was a gelding, and four were mares. Only five were shod.

In determining the age of each animal from the College of Veterinary Science, careful and thorough examination of the teeth, which is one of our most potent methods of finding the age of our larger domestic animals, especially horses, was employed. The age of each animal from the Animal Husbandry Department was taken from the record of the department. The examination of the feet for soundness was based principally upon the obliquity of the wall of the hoofs, the presence and regularity of the striae, or horn fibers, and the presence of normal rings around the hoof wall.

The horses from the College of Veterinary Science, during the entire period of the experiment, were confined in the hospital and they were so kept that wetting their feet with water was avoided as much as possible. So the only possible supply of moisture of the hoofs was from the manure, urine, floor of the stall, and the air. On the contrary, the horses from the Animal Husbandry Department were tied early every morning with long rope in the pasture, under which condition their feet regularly got wet for a few hours every day. It is apparent, then, that the hoofs of the animals from the Animal Husbandry Department received more moisture than those of the animals from the College of Veterinary Science.

It is now generally accepted that the horn tubules and the intertubular substance which constitute the bulk of the wall of the hoof are produced by the proliferation of the cells,—corresponding to stratum germinativum or Malphigian layer of the epidermis,—which cover the papillae and interpapillary spaces of the coronary cushion, and that the growth of the wall is from above downward. This downgrowth of the wall is proven by the fact that if the hoof is marked with a rasp or file, it will be found after some time that the mark is receding from the coronary border and approaching the ground. So it is quite evident that in order to measure the hoof growth, the superior (fixed) point must be above the coronary cushion and the inferior (moveable) point below it. For the superior or fixed point, I used the line between the hair-bearing skin and the periople, that is, the line where the hair ceases to grow, and to make it more distinguishable and easier in taking the measurement I painted it with 40% aquaeous solution of eosin. The inferior, or movable point was represented by a narrow transverse groove on the wall of the hoof, just a little below the level of the coronary groove. This transverse groove was made by means of a fine three-sided file, and deep enough to cut through the stratum tectorium

into the substance of the middle layer of the wall. It may be stated in this connection that in no instance was the groove made more than three millimeters in depth. The groove was made to run parallel to the coronary border and to its corresponding superior line. It was also painted with 40% aquaeous solution of eosin. I might add here that the color of the eosin remained distinct during the entire period of the experiment, especially with the horses which were confined in the Veterinary Hospital.

Only one fore foot and one hind foot of each horse were used, and the toe, the quarters (medial and lateral), and the heels (medial and lateral) were marked according to the method described above. The distance between the superior line and its corresponding inferior groove was carefully taken and recorded as the "initial measurement".

The subsequent measurements were taken at seven-day intervals, and the method by which the measuring was done may be described as follows: By means of a fine pointed compass the distance between the corresponding points (superior and inferior) was taken, and then the distance between the two points of the compass was measured. Great care was observed so as to have the imaginary line connecting the points of the compass coincide with the direction of the striae of the hoof. The weekly measurement and weekly growth of the hoofs of each horse were recorded and computed according to the plan illustrated in Table I.

DISCUSSION OF RESULTS

According to Reeks (1) the growth of the hoof is favored by moisture, but in my observation, as may be noted in Table II, moisture apparently has no material influence upon the rate of growth of the hoof,—the average growth of the hoofs of the horses which had abundant supply of moisture being 9.32 millimeters per month and that of those having very limited supply of moisture 9.18 millimeters per month. If moisture hastens the growth of the hoof the heel must necessarily grow more rapidly than the quarters and the toe, because according to Smith (2) it contains more moisture than the other sections of the wall of the hoof, and if this is the case the assertion of Reeks and other investigators (3), (4), (5), that the wall of the hoof grows uniformly from the coronet, that is, the toe, the quarters, and the heels grow with equal rate, will no longer hold good. But in my experiment it was my observation that one section of the wall grows just as rapidly as another.

With reference to the connection of moisture with the growth of the hoof, in my opinion, excessive amount of it does not affect or alter the rate of hoof growth. Its presence, however, in the horn cells is absolutely indispensable for maintaining its normal growth, because insufficient quantity or lack of moisture renders the horn tissue dry, hard, and unyielding, under which condition the horn growth is hindered. As an explanation to this condition, the following may be suggested: The make-up of the hoof, if analyzed from the standpoint of its origin and morphology, is nothing more than superimposed layers of epithelial cells which have undergone keratinization. The cells forming the wall of the horn tubules are concentrically arranged around their lumen, while those lying between the tubules which constitute the intertubular substance present no definite arrangement. Since the horn tubules and intertubular substance which mainly make up the hoof, as before described, are produced by the proliferation of epithelial

cells which cover the outer surface of the corium of the foot, it is quite legitimate to state that the farther they are traced from the corium from which they arise, the older the horn cells become. Take the wall of the hoof, for instance, the younger cells are located near the coronary border while the older ones near the ground border. Now, if the horn tissue is hard and unyielding due to lack or insufficient quantity of moisture, the younger cells encounter great difficulty in pushing the older ones toward the periphery, as a consequence of which the horn growth is delayed. Furthermore, when the hoof is in a dry state its physiological movements, which have something to do in facilitating the local blood circulation, as will be alluded to in the latter part of this paper, are more or less interfered with.

My finding with reference to the influence of shoeing upon the growth of the hoof agrees more or less with those of Lungwitz (3) and Adams (4), in that unshod hoofs grow more rapidly than the shod. According to my experiment, as may be noted in Table III, the average monthly growth of shod hoofs is 9.03 millimeters, and that of unshod 9.41 millimeters. No attempt, as far as I was able to find, was made by these investigators to explain why the growth of the hoof is favored by the horse going barefooted.

The question is somewhat obscure when viewed from the anatomical standpoint, but if the effects of shoeing on the mechanism of the foot are taken into account, the following theory may be of some help for its elucidation: When the foot comes in contact with the ground the impact of the body-weight is immediately transmitted to its horny wall by the structures contained within the hoof, and in response thereto the wall of the latter dilates laterally both at the ground and coronary borders. Soon after the hoof is relieved of the pressure of the body-weight, it contracts and assumes its original form. The dilatations and contractions of the hoof, which are continually alternating even when the horse is at rest in standing position, produce a sort of a pumping action by which the venous circulation in the foot is largely facilitated. During the dilatation of the hoof the blood is being driven upward and the veins are emptied, and during contraction it is aspirated and the veins are filled. In that way the corium of the foot is insured of a lively blood circulation upon which the rapidity of growth of the horn mostly depends. Now, when the hoof is shod its physiological movements, dilatations and contractions, are more or less restricted or checked at the bearing margin, so that the force of the heart is left with a very little help, if there is any, in emptying the foot of its venous blood and in driving into it the arterial blood that contains the necessary nutritive materials for the horn growth.

Table IV shows the weekly growth of the wall of the hoofs of each individual animal. By comparing the weekly growth at the different sections around the wall of both the anterior and posterior hoofs of each horse, it will be noticed that there is no material difference regarding their rate of growth from the coronary border. The fractional difference that may be observed in some cases, I think, is only due to the fact that the fractions of a millimeter below five-tenths were omitted in recording the weekly measurements of the different sections. This shows that the wall of the hoof grows downward almost uniformly from the coronet, that is, the rate of growth at all sections,— the toe, the quarters, and the heels,—in the wall is almost regular. If such is the growth of the hoof, it is very natural to expect that the age of the horn cells at the bearing or ground border of the wall varies according as the toe, the quarters, or the heels are under

consideration. The toe being the highest section of the wall naturally possesses the oldest cells at its bearing border, and the heels being the shortest have the youngest.

Like the observations of the investigators cited elsewhere in this paper, I found that the posterior hoof grows faster than the anterior. The average monthly growth of the anterior hoof is 8.73 millimeters, whereas that of the posterior hoof is 9.76 millimeters. No explanation can at present be offered why the posterior hoof grows more rapidly than the anterior hoof.

If the average weekly growths of the hoofs of horses Nos. 7 and 9 which are the youngest of the horses used are compared with those of other horses, it will be observed that the age of animal has no apparent effect on the rate of growth of the hoof. Also it will be observed, if the growths of the hoofs of animals of both sexes and of different size and color are examined, that sex, size, and color have no relation at all to the rapidity of growth of the hoof. This observation regarding the relation of sex to the growth of the hoof is contrary to that of Adams who states that the hoofs of the mares grow more rapidly than those of the stallions.

Taking the average of growth at the different sections around the wall of the anterior and posterior hoofs of animals of both sexes and of different color and size, it gives an average growth of 9.25 millimeters per month. This rate is a little higher than what has been given by the following authors for horses of foreign breed:

Reeks (1) ..... ¼″ or 6.35 millimeters per month.
Lungwitz (3) ..... 5/16″ or 8 millimeters per month.
Adams (4), (5) ..... ⅓″ or 8.46 millimeters per month.

If the average growth is 9.25 millimeters per month, the length of time required for the complete renewal of the hoof of native horses at any section varies according to the height of the toe, the quarters, and the heels. According to my own observation the height of the wall of the hoof of native horses is from 7 to 9 centimeters at the toe, 5 to 7 centimeters at the quarters, and 3 to 5 centimeters at the heels. So it is apparent that the time required for the horn to grow from the coronary border to the ground border of the wall is about 7 to 10 months at the toe, 5 to 8 months at the quarters, and 3 to 6 months at the heels.

SUMMARY OF CONCLUSIONS

1. The average growth of the hoof of native horses is 9.25 millimeters per month.
2. Excessive amount of moisture has no effect on the rate of growth, but what the hoof requires for maintaining its normal growth is that quantity of moisture just sufficient to keep its normal elasticity and yielding character.
3. Unshod hoofs grow somewhat faster than shod.
4. Posterior hoofs grow more rapidly than anterior.
5. The rate of growth of the wall of the hoof is almost regular around the coronet.
6. Apparently age, sex, color, and size of the animal have no connection with the rapidity of growth of the hoof.

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TABLE I.—*Record of Horse No. 1 illustrating the way the weekly growth of the hoofs of each animal was recorded and computed.*

Date.		Anterior hoof.										Posterior hoof.									
				Lateral.				Medial.						Lateral.				Medial.			
				Quarter.		Heel.		Quarter.		Heel.				Quarter.		Heel.		Quarter.		Heel.	
		Toe	Weekly growth.		Weekly growth.		Weekly growth.		Weekly growth.		Weekly growth.	Toe.	Weekly growth.		Weekly growth.		Weekly growth.		Weekly growth.		Weekly growth.
		mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
Mar. 17	Initial measurement.	25		22		23		25		26		26		27		25		27		25	
			2		2		2		2		2		3		3		2		3		1
Mar. 24		27		24		25		27		28		29		30		27		30		26	
			3		3		2		2		2		2		2		3		2		2
Mar. 31		30		27		27		29		30		31		32		30		32		28	
			2		2		2		2		2		3		3		2		3		2
April 7		32		29		29		31		32		34		35		32		35		30	
			3		2		3		2		2		1		2		3		2		3
April 14		35		31		32		33		34		35		37		35		37		33	
			2		2		3		2		2		2		2		2		2		2
April 21		37		33		35		35		36		37		39		37		39		35	
			3		2		2		2		2		2		2		2		3		2
April 28		40		35		37		37		38		39		41		39		42		37	
			2		2		2		2		2		3		3		3		3		3
May 5		42		37		39		39		40		42		44		42		45		40	
			3		2		3		2		2		2		2		3		2		2
May 12		45		39		42		41		42		44		46		45		47		42	

Total growth in ten wks.		24		22		23		21		20		23		25		25		25		23
Average per week.....		2.4		2.2		2.3		2.1		2		2.3		2.5		2.5		2.5		2.3

TABLE II.—*Showing the influence of moisture upon the growth of hoof.*

Horses kept without getting their feet wet.											Horses kept with their feet wet every morning.										
	Anterior hoofs.					Posterior hoofs.						Anterior hoofs.					Posterior hoofs.				
		Lateral.		Medial.			Lateral.		Medial.				Lateral.		Medial.			Lateral.		Medial.	
Horse No.	Toe.	Quarter.	Heel.	Quarter.	Heel.	Toe.	Quarter.	Heel.	Quarter.	Heel.	Horse No.	Toe.	Quarter.	Heel.	Quarter.	Heel.	Toe.	Quarter.	Heel.	Quarter.	Heel.
	mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*		*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
1	2.4	2.2	2.3	2.1	2	2.3	2.5	2.5	2.5	2.3	6	2.2	2.2	2.3	2.1	2.3	2.5	2.5	2.5	2.4	2.4
2	2	2.2	2.4	2.3	2.1	2.5	2.3	2.3	2	2.1	7	2.1	2.1	2.2	2.4	2.4	2.6	2.7	2.6	2.4	2.7
3	2.4	2.3	2.4	2.3	2.2	2.5	2.5	2.3	2.5	2.4	8	2.2	2	2.1	2.3	2.2	2.5	2.6	2.5	2.5	2.7
4	2.3	2.4	2.3	2.2	2.2	2.5	2.4	2.4	2.4	2.4	9	2.1	2.2	2	2	2	2.5	2.4	2.5	2.4	2.4
5	2.2	2.1	2.1	2	2.1	2.4	2.5	2.1	2.2	2.5	10	2.2	2	2	2	2	2.5	2.6	2.6	2.3	2.5
Average.....	2.26	2.24	2.30	2.18	2.12	2.44	2.44	2.32	2.32	2.34	Average...	2.16	2.12	2.1	2.18	2.18	2.52	2.58	2.54	2.4	2.54

a. Average monthly growth of hoofs with limited supply of moisture = 9.18 mm.
b. Average monthly growth of hoofs with plenty of supply of moisture = 9.32 mm.

TABLE III.—*Showing the influence of shoeing upon the growth of hoof.*

Horses with shod hoofs.											Horses with unshod hoofs.										
	Anterior hoofs.					Posterior hoofs.						Anterior hoofs.					Posterior hoofs.				
		Lateral.		Medial.			Lateral.		Medial.				Lateral.		Medial.			Lateral.		Medial.	
Horse No.	Toe.	Quarter.	Heel.	Quarter.	Heel.	Toe.	Quarter.	Heel.	Quarter.	Heel.	Horse No.	Toe.	Quarter.	Heel.	Quarter.	Heel .	Toe.	Quarter.	Heel.	Quarter.	Heel.
	mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*		*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
1	2.4	2.2	2.3	2.1	2	2.3	2.5	2.5	2.5	2.3	3	2.4	2.3	2.4	2.3	2.2	2.5	2.5	2.3	2.5	2.4
2	2	2.2	2.4	2.3	2.1	2.5	2.3	2.3	2	2.1	4	2.3	2.4	2.3	2.2	2.2	2.5	2.4	2.4	2.4	2.4

10	2.2	2	2	2	2	2.5	2.6	2.6	2.3	2.5	9	2.1	2.2	2	2	2	2.5	2.4	2.5	2.4	2.4
Average.....	2.2	2.14	2.26	2.1	2.1	2.44	2.48	2.4	2.28	2.36	Average.....	2.22	2.2	2.2	2.24	2.2	2.52	2.52	2.46	2.44	2.52

a. Average monthly growth of shod hoofs = 9.03 mm.
b. Average monthly growth of unshod hoofs = 9.41 mm.

TABLE IV.—*Summary of the average weekly growth of the hoofs of each horse.*

						Anterior hoofs.					Posterior hoofs.				
							Lateral.		Medial.			Lateral.		Medial.	
Horse No.	Age.	Sex.	Color.	Wt.	Ht.	Toe.	Quarter.	Heel.	Quarter.	Heel.	Toe.	Quarter.	Heel.	Quarter.	Heel.
	Yrs.			*lbs.*	*inch*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
1	7	Male....	Bay.....	480	47	2.4	2.2	2.3	2.1	2	2.3	2.5	2.5	2.5	2.3
2	3½	Male....	Mouse...	500	46	2	2.2	2.4	2.3	2.1	2.5	2.3	2.3	2	2.1
3	10	Female..	Bay.....	420	45	2.4	2.3	2.4	2.3	2.2	2.5	2.5	2.3	2.5	2.4
4	8	Male....	Iron Gray	550	49	2.3	2.4	2.3	2.2	2.2	2.5	2.4	2.4	2.4	2.4
5	5	Male....	Black....	535	48	2.2	2.1	2.1	2	2.1	2.4	2.5	2.1	2.2	2.5
6	9½	Male....	Cream...	578	51	2.2	2.2	2.3	2.1	2.3	2.5	2.5	2.5	2.4	2.4
7	1¼	Male....	Chestnut.	454	44	2.1	2.1	2.2	2.4	2.4	2.6	2.7	2.6	2.4	2.7
8	7	Female..	Chestnut.	611	48	2.2	2	2.1	2.3	2.2	2.5	2.6	2.5	2.5	2.7
9	2	Female..	Chestnut.	618	47	2.1	2.2	2	2	2	2.5	2.4	2.5	2.4	2.4
10	9	Female..	Dun.....	618	50	2.2	2	2	2	2	2.5	2.6	2.6	2.3	2.5
Average.....						2.21	2.17	2.21	2.17	2.15	2.48	2.5	2.43	2.36	2.44

a. Average monthly growth of anterior hoof = 8.73 mm.
b. Average monthly growth of posterior hoof = 9.76 mm.
c. Average monthly growth of anterior and posterior hoofs = 9.25 mm.

PARASITES OF LOWER ANIMALS DANGEROUS TO MAN IN THE PHILIPPINE ISLANDS[1]

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It is said that the advance made by any nation is measured largely by its treatment of diseases. In tropical countries one of the biggest problems to be solved before the highest plane of development can be reached is the control of parasitic diseases, those affecting human beings and those the domestic animals suffer from. This assertion is based on the fact that in hot countries zooparasites, which are a great menace to the health and life of man and the lower animals, find conditions of warmth and moisture which are favorable for their existence and propagation. In the Philippine Islands these conditions obtain and so it is to be expected that parasitic diseases would be prevalent. Unfortunately the data which are available at the present time are not sufficient to give us due warning of all the possible dangers in our midst since the field of parasitology, in spite of its importance, has been little exploited here. Judging, however, from the work which has already been accomplished, the indications are that parasitic diseases are exerting unfavorable influences which are not being seriously considered.

It was a common belief not very many years ago that parasites were harmless creatures on which zoologists lavished too much attention. That belief, however, has been shown to be not only erroneous but dangerous, so that at present scientific men put parasites in the same category as other disease-inciting agents. There are parasites like the Egyptian intestinal fluke, *Heterophyes heterophyes*, and others which are claimed by some helminthologists not to cause any visible damage to their hosts; but even these should be regarded with some degree of suspicion because there are certain obscure effects of parasitism which cannot yet be accurately gauged. It should be considered that there must be certain metazoan parasites, as there are certain forms of microorganisms, which seem to possess very little pathogenic power, but, because of their close association with their hosts and the continued application of their pathogenicity they may be able sooner or later to give rise to certain symptoms of disease some of which might have been interpreted as anaphylactic in nature.

It is not the intention of this paper to give a detailed account of the effects of parasitism. Reference, however, should be made to the results of recent investigations bearing on the relationship between meta-and proto-zoan parasites in the production of specific diseases; for they serve to emphasize further the complex significance of parasitic infestation. Theobald Smith and Graybill (1, 2) in their work on blackhead found that the nematode parasite, *Heterakis papillosa*, which is commonly found in the ceca of chickens and other birds, is an important factor in the incidence of the disease. In several controlled ex-

[1] Experiment Station Contribution No. 113. Read at the 11th Annual Meeting of the Philippine Veterinary Medical Association, February 13, 1923.

periments they produced blackhead in turkeys and chickens by feeding them the ripe eggs of the parasite. From their results it was evident that the rôle played by the nematode parasite is either that of an accessory agent which so lowers the resistance of the birds as to make them susceptible even to light infections with *Histomonas* (*Amoeba*) *meleagridis;* or that of an invertebrate host which is able to transmit the organism of blackhead from bird to bird. The latter possibility seems to be supported by the results later obtained by Tyzzer and Fabyan (3). These two investigators after rendering cultures of ripe *Heterakis* eggs bacteriologically sterile by immersion in 1.5% nitric acid solution fed them to young turkeys. Several days after the feeding experiment, the turkeys developed blackhead. Although morphological evidence was lacking to show the presence of *Histomonas meleagridis* inside the nematode eggs, it could only be deduced from their results that the organism of blackhead was contained and protected within the substance of the eggs of *Heterakis papillosa* and that it was liberated in an infectious state when the nematode eggs hatched out in the intestines of the birds.

The significance of these discoveries can readily be appreciated by those who have had field experience and have seen disease outbreaks. What if that which we have been taught to regard as "spontaneous cases" of tetanus, anthrax, blackleg and other diseases are due to the introduction of specific organisms by ingested zooparasite eggs? Some helminth eggs when they hatch liberate larvae which penetrate through the intact walls of the intestines and by so doing they may carry with them, or at least prepare the way for the entrance of, pathogenic organisms present in the intestines. And what if, as in the case of blackhead, rinderpest, hog-cholera and the like can be propagated by the eggs of metazoan parasites? Blackhead is caused by a protozoon which is big enough to be seen under an ordinary microscope. The etiology of rinderpest or of hog-cholera, on the other hand, is supposedly so small as to be invisible with the aid of the most powerful lenses, so that its inclusion within the substance of a helminth egg is more conceivable. Here then is another big problem for anyone who is interested in infectious diseases and in animal parasites. Who would have thought that the Texas fever organism, *Piroplasma bigeminum*, could be transmitted by the cattle tick, *Margaropus annulatus?* Until we have searched everywhere and determined all the possible sources of pathogenic organisms and their methods of entry into the systems of susceptible animals, our efforts to prevent and to eradicate infectious diseases will never be wholly successful.

PARASITES AFFECTING BOTH MAN AND LOWER ANIMALS

Although as a general rule the parasites of different species of animals, including man, are not intertransmissible, there are a few which have been reported to occur both in man and in some of the lower animals. Some of these parasites are found in the Philippine Islands.

ASCARIS LUMBRICOIDES

Ascaris lumbricoides is a very common intestinal parasite of man and the domestic pig throughout the world. The name *Ascaris suilla* has been used to designate the form occurring in the pig, but according to Ransom (4) and others the pig *Ascaris* is morphologically and biologically identical with the *Ascaris* of man.

This roundworm has often been lightly treated in text-books, but because of the recent findings on the real nature of its life-history, it is now considered as one of the most dangerous parasites. Briefly its life-history is as follows: The eggs which are laid by the mature female worm in the small intestines are eliminated with the feces of the host. When these eggs reach the open air, they are in the early stages of segmentation and are not infectious. If they meet with favorable conditions of warmth and moisture on the ground or elsewhere, they continue to segment until after 10 to 14 or more days they become ripe eggs containing motile embryos. At this stage if they are swallowed by a suitable host, they hatch in the intestines. The newly hatched larvae, instead of simply settling down at once to pursue further development, penetrate through the walls of the intestines and are carried by the circulation to the lungs, principally, by way of the liver and heart. They stay in the lungs for a certain length of time, meanwhile increasing slightly in size, and then they follow the course of the bronchioles to the trachea. From the trachea they work their way to the oesophagus and are then swallowed. Finally these developing larvae settle down in the small intestines and continue to grow to maturity.

Ascaris larvae during their migrations through the lungs may affect the host animal seriously. The so-called disease "thumps" of young pigs is attributed to their presence in large numbers in the lungs. They have also been observed to produce pneumonia in these animals. In addition they may act as active mechanical agents in the introduction of pathogenic microorganism into the tissues. Animals which are heavily infested with *Ascaris* larvae are usually stunted in their growth. In human beings, especially in children, similar disturbances with attendant lung symptoms have been reported from various sources. It is, therefore, important to know the relative distribution of this parasite in the Philippine Islands, so that proper preventive measures may be instituted. According to the different parasitological surveys which have been made in various parts of the Islands, 50% to 62% of the population are parasitized with *Ascaris lumbricoides*. In native pigs, on the other hand, the incidence of *Ascaris* infection is less definitely determined. According to the limited number of observations which have been made so far, this parasite is said to be rare in adult Philippine swine. This fact is difficult to believe at first, considering the environment which makes it easy for pigs to pick up *Ascaris* from the soil. One writer (5) is inclined to attribute its scarcity to a possible resistance of Philippine pigs to this worm. Whether or not such a resistance really exists has not been proved by experiment. In this connection it may be of interest to mention the results of autopsies made by Dr. Angel K. Gomez and the writer on fifteen young pigs, not over four months old, sent to us at different times from the Animal Husbandry Department of the College of Agriculture, University of the Philippines. Eight of these, or 53.3%, harbored fairly-well developed but immature *Ascaris lumbricoides* in the small intestines. All the positive pigs were lightly infested, however, the maximum number of worms found in any one of them being five. This evidence, since it concerned only a small number of animals which, too, had all been exposed to practically the same conditions, at about the same time, is not conclusive. It is to be noted, though, that lightness of infestation has been found in older animals so these observations may be used to add weight to the

statement that *Ascaris lumbricoides* is rare in native swine. It seems, however, that it is rare, not in the sense that the pigs are resistant to infection, but rather in the sense that they are very lightly parasitized; for if the percentage of infection (53.3%) is compared with the figures of Ransom and Foster (6) in American swine, it will be shown that the native pig is no less susceptible. Perhaps the failure to find the parasite in many adult native swine is due to the fact that the few worms which might have been picked up during early life are dropped out as the animals grow older.

In the light of these observations it appears likely that we must look for other factors which may be responsible for the scarcity of *Ascaris lumbricoides* in native swine. One of these factors may be concerned with the fact that in the Philippines domesticated animals are not yet crowded together in limited areas of territory. When animals are provided with a wide range, as is the case in the wild state, the danger from infection with parasites is little because the chances of picking them up from the ground are few. Another factor may have to do with the peculiarities of our climatic conditions. In places where the conditions of warmth and moisture do not change much throughout the year, it is possible that parasitic life in the ground can go on uninterruptedly. In the case of many regions of the Philippines, on the other hand, during the dry season the soil gets very warm (43° C. or over) during certain hours of the day. According to our findings (7) on the susceptibility of *Ascaris* eggs to higher temperatures, this heat, applied as it is for certain lengths of time daily, would be high enough to destroy most helminth eggs. Due to this action of the sun's rays there is, therefore, a yearly destruction taking place which prevents a too concentrated infection of the soil with parasite eggs and which lessens the possibilities of infection of animals. In cold countries the same results may not be noted in spite of the radical changes of temperature during winter, for it has been observed that most helminth eggs are better able to stand for longer periods of time low than high temperatures.

The comparative scarcity of *Ascaris lumbricoides* in native swine is a thing in our favor, but it should not make us any less careful because the parasite is very common in man. Prophylaxis consists in the observance of sanitary regulations like the proper disposal of all excreta by the construction of sanitary toilets, in not allowing pigs to roam at large, especially in places where children are apt to play, in pen rotation in the case of swine, etc. Chickens must not be allowed to gain access to human or suilline excreta, for if they swallow the eggs they are able to spread *Ascaris* (7). Young individuals should especially be given prophylactic attention, for they are the most susceptible to infection. For the expulsion of these worms from the intestines oil of chenopodium has been found to be very efficacious. According to Ransom and Hall (8) it is given to swine in doses of 4 mils per hundred pounds of live weight with 2 to 4 ounces of castor oil.

ANCYLOSTOMA DUODENALE AND *NECATOR AMERICANUS*

These intestinal parasites are commonly designated as hookworms. They are responsible for the disease known as ancylostomiasis or hookworm disease which is characterized in man by anemia, dullness, emaciation and digestive disturbances. *Ancylostoma duodenale* is sometimes called the Old World (European) hookworm and *Necator americanus*, the New World (American) hook-

worm. Both forms are present in the Philippines and according to various investigators 31% to 52% of the population are parasitized by either one of them or by both.

Historically[1], ancylostomiasis became known as a serious disease in 1880 during an epidemic of anemia among workers constructing the Saint Gothard tunnel. At first there was much discussion as to the real cause of the malady, some maintaining that it was due to insanitary surroundings. During that controversy the only scientist who insisted on the parasitic origin of the disease was Edoardo Perroncito, a professor of pathology at the Veterinary School of the University of Turin. Since that time several outbreaks of hookworm disease have been reported and suppressed in different parts of the world and especially in the mining districts of Europe. At the present time much eradication work is going on in tropical and subtropical countries, including the Philippines, where the disease is prevalent.

Formerly the methods used in the eradication of hookworm disease were not very satisfactory, for it was not accurately known how the parasite gained entrance into the body. It was believed that infection entered solely through the mouth, but in 1898 Looss showed that the disease can be introduced through the skin. As a result of this important discovery of Looss, prophylactic measures have been modified and are directed to the prevention of soil pollution with hookworm larvae by the proper disposal of human excreta and protection of the exposed parts of the body with proper footwear and gloves. Satisfactory treatment with oil of chenopodium and recently with carbon tetrachloride has aided these preventive measures in reducing the incidence of the disease.

Recently some very interesting facts concerning the propagation of ancylostomiasis by domestic animals have been published. In a series of experiments Ackert (9) has found that hookworm eggs are able to hatch and to develop into infective larvae after passing through the alimentary tract of the domestic chicken. In collaboration with Payne he (10) also determined that hookworm eggs which are swallowed by the domestic pig can later develop into infective stages. In places, therefore, where these two animals, the domestic pig and chicken, can gain access to human excreta, the danger of their spreading the disease is great.

The life-history of a hookworm, including the dog hookworm, is briefly as follows: The eggs which are eliminated with the feces of the host are in different stages of segmentation and they soon hatch if they meet with favorable conditions in the outside world. The newly hatched larvae are, however, not dangerous and they only become infectious after a few days, during which they molt several times. At this stage if they are swallowed by a suitable host, some of them may be able to complete their development in the small intestines. More often, however, the path of infection is through the skin. The infectious larvae by their ability to penetrate through the skin, are carried to the lungs by the circulation. From the lungs they go to the trachea and then work their way to the oesophagus until they are swallowed. In the small intestines they continue to grow to maturity.

Ancylostoma duodenale and *Necator americanus* are parasites of man. They are discussed here due to the possibility of their infecting the dog and other

[1] Bibliography of hookworm disease, Rockefeller Foundation Publication No. 11. (1922).

domestic animals which, because of their habits, may serve as factors in the spread of the disease. In fact there are already on record instances which confirm this view. In 1921 Stiles (11) reported before the Helminthological Society of Washington that in a collection of worms from the dog in the Southern United States, some specimens which are apparently *Necator americanus* are found with *Ancylostoma caninum*, the dog hookworm. Another species, *Ancylostoma ceylanicum*, but which fortunately has not been found in the Philippines, has long been known to infect both man and the dog.

OTHER PARASITES

Lungworms.—A species of lungworm which is apparently *Metastrongylus elongatus* has frequently been found in the lungs of pigs slaughtered at Los Baños. In young animals it is often responsible for the condition known as verminous bronchitis, which often has a fatal termination. It has been reported in human beings from other countries, but in the Philippines not a single case is recorded.

The life-history of this parasite is simple. The eggs hatch in the lungs and the larvae are either coughed out with the bronchial secretion or are swallowed and eliminated with the feces. In the open they develop into infective stages and, if swallowed by a proper host, they work their way through the trachea to the bronchi and bronchioles where they remain to complete their growth. Prophylaxis is a matter of cleanliness. Treatment is not very satisfactory. Herms and Freeborn (12) recommend the injection of chloroform into the nostrils with a medicine dropper in sufficient quantities to produce "grogginess' (about 5 mils in swine).

Tapeworms.—Several species of tapeworms are known to occur in the Philippines. *Taenia saginata*, the larval form of which is *Cysticercus bovis* of cattle and *Taenia solium*, the larval form of which is *Cysticercus cellulosae* of swine, have in several instances been found in Filipinos. These parasites like many others are detrimental to the health and growth of their hosts. In order to prevent infestation with them, meat inspection regulations to do away with carcasses harboring larval tapeworms should be enforced in every locality. This is necessary when it is considered that at least 1% of all the pigs slaughtered in Manila are affected with *Cysticercus cellulosae* (13). No records are at hand for native cattle but it is presumed that they harbor *Cysticercus bovis* due to the existence in man of the adult parasite, *Taenia saginata*.

Dipylidium caninum, a very common parasite of the dog in the Philippine Islands, has been reported by Mendoza-Guazon (14) in a Filipino child. The larval stage lives in the sucking louse of the dog, *Trichodectes canis*, in the dog flea, *Ctenocephalus canis*, and in the human flea, *Pulex irritans*.

The first case of infection with *Hymenolepis diminuta* in a Filipino is recorded by Schwartz and Tubangui (13). This is a very rare parasite of man throughout the world, but in the rat it is quite common. The larval stage is found in the rat flea, *Ceratophilus fasciatus*, and in other insects like the dog and human fleas and in certain beetles according to some investigators.

Flukes.—Of the flukes found in the Philippines two species are known to infect man and some of the lower animals. One is *Paragonimus westermanni*, a parasite of the dog, cat, hog and tiger. Musgrave (15) has reported

seventeen cases in man of paragonimiasis from the Philippines and he has also seen the parasite in one native cat. The fluke is usually located in the lungs giving rise to symptoms which might be mistaken for tuberculosis. Infection with this parasite has often proved fatal There is no satisfactory treatment known. The best that can be done is to institute good hygienic measures and to prescribe rest and general tonics. Prophylaxis consists in the avoidance of the intermediate hosts of the parasite. According to Japanese writers the first intermediate hosts are fresh water snails belonging to the genus *Melania* in which the miracidia coming from the eggs of the mature fluke develop into sporocysts, rediae and cercariae. The cercariae, on leaving the snails, go to encyst in the bodies of certain crabs which, if eaten raw or not sufficiently cooked, will transmit the parasite. In the Philippines species of Melania snails are abundant in fresh water rivers and creeks, but it is not known if they harbor the larval stages of *Paragonimus westermanni.*

The liver fluke, *Fasciola hepatica*, of cattle and other herbivores is very prevalent. Musgrave (15) also records one case of infection in man with this parasite from the Philippines. The larval stages of *Fasciola hepatica* are spent in snails (Genus *Limnaeus*). The cercariae usually encyst on blades of grass but occasionally they may also encyst in water. Man probably gets the infection by drinking water which contains these cysts. The specific intermediate host of this parasite has not been determined in the Philippines although it is presumably a snail. Prophylaxis consists in not putting animals on low pastures and in the destruction of snails which act as intermediate hosts by proper drainage or by treating the water with chemical poisons like copper sulfate, salt or lime. A very satisfactory method of treatment is not known although it is claimed that oleoresin of male fern in doses of 12 to 25 grams and powdered kamala in amounts of 15 grams, given in 1 to 5 gram doses, for cattle have given good results.

CONCLUSION

There are many important parasitic diseases in the Philippine Islands which could have been described, but only those which may affect both man and some of the lower animals have been chosen with the aim of arousing a common interest among scientific men who by their training are considered leaders in public sanitation and hygiene. As has been stated elsewhere, ours is a tropical country where the dangers from parasites are great, and unless proper measures are taken all efforts to reach the highest plane of development will always be seriously impeded. It is no longer for us to doubt the retarding and degenerating effects of parasitism because they have been demonstrated in the history of many nations. Around us there are telling facts which are undoubtedly due to parasitic influences. It is for the physicians, veterinarians and other scientists to warn the public and to teach it how to avoid parasites. The government is doing its share in having the subject of parasitology taught in our University, but it can go further by giving more encouragement for research to those who are interested. The urgent need for this is evident when it is considered how many losses in life and property and how much suffering are sustained every year from the ravages of malaria, hookworms, surra, dysentery and many other diseases which are caused by zooparasites.

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RULES FOR THE PURPOSE OF PREVENTING THE INTRODUCTION OF COMMUNICABLE DISEASES OF ANIMALS[1]

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The following rules should be adhered to by persons in charge of livestock for the purpose of preventing the introduction of communicable diseases of animals as well as preventing the spread of these diseases should they occur.

1. When cattle, carabaos, or other animals are purchased, they should always be treated as having been exposed to infection.

2. When animals are being moved from one locality to another, they should not be allowed to mix with other animals "en route". They should travel during the cool time of the day.

3. When cattle and carabaos are purchased, on being brought to the purchaser's premises, they should be kept by themselves and not allowed to mix with the old cattle of the farm in the pasture, at the watering place or at any other place. They should be kept by themselves for at least one month in order to ascertain whether or not they are affected with a contagious disease. During that time the newly purchased cattle and carabaos should be carefully inspected morning and evening, and if any disease appears among them the affected animals should be isolated at once and the services of a veterinarian secured. The remaining animals should be separated into smaller lots and picketed at some distance apart. At the end of one month, if no disease has appeared among them, they may be safely pastured and kept with the other carabaos and cattle.

4. When cattle and carabaos are traveling, or are moved from one district to another, they are likely to be exposed to contagion and may contract disease; therefore, on their arrival at home, they should be carefully inspected, and if they have passed through an infected district they should be kept by themselves for sometime.

5. When a disease of a contagious nature, or supposed to be of contagious nature, appears among animals, the first important duty of a person in charge of the stock is to separate the sick from the healthy ones.

6. Carefully inspect all the animals, and remove to a place designated as the hospital any animal showing the slightest symptom of disease.

7. Divide the healthy animals into several lots, making each lot as small in number as space will permit. Picket the animals in such lots a good distance apart and to the windward of the sick animals. Frequently inspect each lot and remove at once any animal showing symptoms of disease. By following this plan strictly the disease will be found in a few days to exist only among one or two lots, and by removing at once to the hospital any sick animals the disease will be speedily arrested and will not spread throughout the herd.

8. The hospital for the diseased animals should be isolated and enclosed with a strong fence. The sick animals should not be permitted to leave the isolated

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[1] Experiment Station Contribution No. 114.

area. The attendants should not be allowed to leave the hospital without changing their clothes and disinfecting their hands and feet. Food and water may be taken to the attendants and to the sick animals, but no forage, or water or litter, or clothing or anything should be taken from the hospital. DOGS SHOULD NOT BE ALLOWED TO GO TO AND FROM THE HOSPITAL AS THEY MAY CARRY CONTAGION TO PLACES WHERE HEALTHY STOCK ARE LOCATED.

9. The dry litter and other waste of the hospital should be burned inside the hospital area, and the moist dung and discharges should be frequently removed from the stalls and buried in pits dug in the hospital premises. These pits should be six feet or more deep, and should be filled with the wet litter, dung, etc., of the hospital up to within two feet of the surrounding ground surface and then quick-lime and good fresh earth should be used to fill up the remaining two feet.

10. The hospital should be disinfected frequently and should be kept in a sanitary condition It should have good ventilation.

11. The constant burning of sufficient litter, opposite the doors on the windward side of the buildings is a good plan in seasons when flies are troublesome to animals. Flies are frequently agents for spreading disease.

12. The sick animals should be kept scrupulously clean and have thin rice gruel and fresh green grass for diet. The healthy animals should be kept clean also and should be kept on soft laxative food as cattle and carabaos fed on hard, dry food develop the disease in a more severe form than those fed on laxative fodder.

13. When contagious diseases have prevailed among cattle and carabaos they should not be allowed to pasture with unaffected herds until one month has expired after the last case of disease occurring among the affected lot.

14. Animals that recover should be well washed with warm water and soap prior to being removed from hospital, and if obtainable, enough carbolic acid should be added to the warm water to make a 2% solution.

15. Carcasses of animals that die from contagious disease should be burned whole whenever possible on the spot where the animal died. If burning is not practicable they should be buried deep and covered with at least 4 feet of earth. The hides of the animals that die from communicable diseases should be destroyed with the carcasses.

16. The top surface of the earth, of stalls, or any ground on which animals affected with contagious diseases have been kept, should be removed and buried, and the earth below should be well dug up and turned over and remade with fresh earth. If the floor is of wood, brick, stone, or cement, it should be scraped, washed, and disinfected with quick-lime or carbolic acid.

17. The poles of carts or harness or saddlery, etc., used by animals affected with contagious diseases should be washed and disinfected. If not of much value, it is better to burn them.

18. The periods of incubation of rinderpest, haemorragic septecimia, anthrax, foot and mouth disease, etc., are well within the period of 28 days; so a month has been named as ample time for an animal supposed to have been exposed to the contagion of these diseases, to be kept isolated. When contagious pleuropneumonia is suspected the time of observation should be extended to at least three months.

19. The application of the above rules in all cases of contagious, infectious and communicable animal diseases is essential; but in case of the diseases for which a preventive inoculation has been devised, they can in many cases be modified and made less irksome. Disinfection in every way is always essential; but if animals are protected against a disease, measures of segregation can in many cases be relaxed. Professional assistance should always be obtained if available and preventive inoculation instituted.

STABLE FLOORS[1]

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The question of floors and flooring probably gives rise to more discussion and divergence of opinion than any other single feature in the construction of animal habitations. The difficulty lies in the fact that three distinct classes of requirements must be recognized and catered to as far as possible, namely, the owner's, the animal's, and the sanitarian's. The owner demands that the floor be durable and economical, the animal requires that it be safe and comfortable, and the sanitarian that it possess hygienic features. It is needless to say that this is a combination of properties difficult to obtain in any one material; in fact, it is impossible to find any one material in use at the present time which embodies them all. The flooring of buildings intended for horses is always a more complicated matter than when other species of animals are to be housed, the reasons for this being that horses are of relatively greater weight, are shod with iron and steel and are often addicted to frequent stamping. Our attention is mainly directed to that phase of the question which deals with horses and the demands in the way of stable flooring which their presence creates. The same general remarks will apply where other species are involved, due allowance, of course, being made for modification of details.

THE REQUIREMENTS FOR AN IDEAL FLOOR

As previously mentioned, a floor must be durable, not only for economic reasons but from a sanitary standpoint as well. In order to insure durability it is imperative that all floors, no matter of what material, rest on a solid, firm foundation. The most satisfactory way of providing this is by excavating the earth to a depth of five to six inches and laying a bed of well tamped, crushed rock covered with concrete. A floor not laid on a compact foundation will sink in places and if made of concrete will crack. The crevices and depressions collect and retain water and urine and through constant saturation tend to subside still further resulting in a rough uneven surface. In addition they lead to the evolution of offensive gases of decomposition due to the polluted condition of the subsoil.

The more hard and dense is the structure of a floor, the more impervious it will be to moisture. The hardness adds materially to its wearing qualities since absorption of moisture together with constant pressure is the principal cause of disintegration. A floor with a hard, compact, impervious surface is, therefore, lasting besides presenting a most important hygienic feature. Unfortunately, however, the surface of such a floor is smoother than one less compact which makes it, particularly when wet, slippery. The accumulation of dirt, especially that of a greasy nature, in the small pores of the surface increases the smoothness as does also the polishing effect which results from friction with animals' shoes passing over it. Although a floor with a hard, compact surface

[1] Experiment Station Contribution No. 115.

is objectionable from the horse's standpoint for the reason stated, it is most desirable from that of the hygienist. Thorough cleaning is facilitated and drying occurs quickly. There is no absorption of urine by the material nor lodgement of particles of solid excreta. This feature assumes additional importance when the fact is borne in mind that the animal while stabled is securely confined to a rather restricted area and must of necessity live and eat in the same place and rest on the same floor where it defecates and urinates.

Another essential requirement for a hygienic floor is non-porosity. The importance of this is due to the necessity of preventing the permeation of the subsoil with urine and other decomposing organic matter. Rise and fall of the ground water is constantly occurring and it imparts its movement to the soil air above. During the rise of the ground water, soil emanations are forced out and where surface pollution is great, as in the neighborhood of inhabited buildings, it is a common cause of vitiated atmosphere. Furthermore, the air within a building, especially one with walls, is generally warmer than the outside atmosphere and owing to the higher temperature the structure acts as a suction pump to the soil on which it stands. While no specific disease of animals can be pointed to as directly attributable to the breathing of impure air, yet it contributes together with other insanitary conditions to a general lowering of the vitality and hence of the animal's body resistance.

To the foregoing features others must be added if all the requirements of an ideal floor are to be met. The animal demands an even level surface, not too hard and compact, but one slightly yielding so that it may relax the muscles and supporting structures of its limbs while standing. Safety from accidents requires that the floor be not slippery. On lying down the surface must be free from dampness and not too hard. Sanitation requires that the floor be well drained, gradually sloping towards the rear at a gradient of about one in seventy. Inasmuch as the keeping of animals is usually a business matter, the owner demands a small initial cost and infrequent cheap repairs.

FLOORING MATERIALS

While there are several materials which may be used for flooring, there is one which stands out pre-eminently. Everything considered, cement-surfaced concrete unquestionably makes the best all-round floor and, while not be any means perfect, it approaches more closely an ideal structure than does any other material. Of all the materials in common use it is the most durable if properly laid and is relatively cheapest. It is non-absorbent and for all practical purposes non-porous. It is easily drained and cleaned and affords an even, level standing surface from which water evaporates quickly. Such floors are frequently objected to on the ground that they are slippery. This defect may be overcome to a considerable extent by grooving the surface in straight lines. The grooves should be not less than one half inch deep and should run, as nearly as possible, at right angles to the direction usually taken by animals entering or leaving the building. Arrangement of the grooves in herring-bone fashion is preferable to a checkered pattern as cleaning is facilitated. Cleaning the floor with a stiff wire brush tends to preserve a slight roughness of the surface and overcomes the effects of friction and prevents the lodgement of dirt. While concrete floors are held responsible for many accidents, especially to horses, an investigation will usually disclose that other factors besides the

slippery surface have been a contributory cause. In stables where accidents occur the passage-way at the rear of the stalls will generally be found to be too narrow and the turnings at doors and other passages too sharp and abrupt. Improper handling of animals, consisting principally in rushing them in and out of a building, is another fruitful source of mishaps. It has been shown from experience that if animals are not hurried, turned slowly, and not frightened, accidents due to slipping become a negligible factor in stabulation. Concrete floors have been in use in many stables for years without giving rise to a single complaint in this regard.

Another shortcoming of a concrete floor is that owing to its hardness it is tiresome for the animal to stand on. As most animals however spend a considerable portion of their time outside of the stable and lie down frequently when within this drawback cannot be considered as serious.

Granite blocks set in concrete and various patterns of vitrified brick provide a fairly satisfactory pavement although their surfaces are slippery. Ordinary building bricks are too porous and being soft they wear rapidly and unevenly so that the life of the floor is short. Wooden floors are objectionable from a sanitary standpoint as they absorb moisture, and rapidly wearing into holes, are not durable. Even wooden blocks treated with creosote are more or less absorbent and their use cannot be recommended. Earthen floors possess the one virtue of being comfortable for the animal to stand on, otherwise their defects are so evident that they may be dismissed without consideration.

As a final comment it may be said that the superiority of cement-surfaced concrete floors is so clearly proved as to entitle them to be regarded as the "last word" in the paving of buildings occupied by animals and their construction is strongly urged by the writer. The constantly increasing use and popularity of these floors indicates a general recognition of their merits which must in time lead to their almost universal use.

COLLEGE AND ALUMNI NOTES

Mr. Joaquin J. Gonzalez, 1919, who is farming in Apalit, Pampanga, continues to perform co-operative work for the Plant Breeding Division of this College. Mr. Gonzalez has just secured several sacks of cuttings of a promising sugar cane seedling variety, produced here by Dr. Mendiola for propagation and test in his farm.

Dr. Mendiola made two trips to the Central Provinces during March. One to the Rice Station of the Bureau of Agriculture at Rosales, Pangasinan, and the other to the Central Luzon Agricultural School at Muñoz, Nueva Ecija.

Arrangement has been made with the Bureau of Agriculture and the Rosales station by which pedigree strains of College rice will be tested in that place. A very important agronomy problem which he found at the Rosales Station and in which our Agronomy Department should be interested is the finding of rice varieties suitable for summer culture under irrigation. The importance of the problem may be realized when it is considered that in a few years thousands of hectares of rice land will be under summer cultivation as a result of the completion of the several irrigation projects now being undertaken by the Government.

The trip to the Central Luzon Agricultural School included a trip to the main site of the Talavera irrigation project. Four alumni of this college are in the faculty of the Central Luzon Agricultural School and these are taking very active part in running that institution. These men believe that a department of rural education should be established in this College for the training of agricultural teachers who will be in great demand as the number of agricultural schools is increased.

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